

4/pets

JC20 Rec'd PCT/PTO 2 4 [10191/3032] JUN 2005

## METHOD FOR TRANSMITTING LOCATION-RELATED INFORMATION

The present invention relates to a method for transmitting location-related information from a transmitter to a receiver.

Patent applications DE 199 42 524.8, DE IP 100 09 149.0, DE 100 04 966.4,

5 DE IP 100 38 343.2, and DE 100 23 309 relate primarily to inventions that make it possible to insert location-related information not present in a digital map into the map. The location-related information may be linear or planiform objects. Examples include ends of traffic jams, parking garages, or side roads, which are not recorded in a digital map.

10 The focus of these applications is on the method for encoding and decoding objects. In this connection, the encoding of objects is understood to be:

- surrounding the objects with location information and descriptive information,
- marking of relevant objects,
- 15 - creating assignment information for assigning the descriptive information to the location information,
- transferring the objects into suitable coordinate chains, or, more generally, the location-related information into a data record,
- displaying the location-related information in a suitable format, including information
- 20 concerning structure and interpretation.

Embodiments may also include only a portion of these steps.

In a standardized configuration, for example, information concerning structure and

25 interpretation of the data may be unnecessary.

In this connection, the decoding of objects is understood to be:

- comparing the geometric information of the supplementing data record and the data
- 30 record to be supplemented, a suitable method being used,

- inserting the supplementary objects into the data record to be supplemented.

The object of the present invention is to provide a method for transmitting the supplementary location-related information from a transmitter to a receiver. A method of the three [sic; five] patent applications cited above may be used, for example, for encoding and decoding.

The object according to the present invention is achieved in each case by the features of the independent claims. Preferred embodiments of the present invention are specified in the dependent claims.

The transmission method of the present invention is advantageous in particular with respect to the marketing of the supplementary location-related information. The supplementary, location-related information is downloaded from an Internet page. As a rule, the special path of the information provision allows the participation of three parties. In the following, these parties are representatively described as information provider, service provider, and user.

The service represents encoding of the location-related information of the service provider. The three parties may appear in different constellations, which are tailored to different financing possibilities of the service. The encoding and decoding methods, which are preferably applied in the method of the present invention for transmitting location-related information from a transmitter to a receiver, are explained in patent applications DE 199 42 524.8, DE IP 100 09 149.0, DE 100 04 966.4, DE IP 100 38 343.2, and DE 100 23 309.

It is a particular advantage that the present invention makes various business models possible for providing location-related information on the Internet. The present invention makes it possible for an information provider such as a restaurant, a movie theater, a company, or another commercial or private institution to provide location-related information on its Internet site in order to make it easier for customers to reach it. In this case, the information provider pays for the encoding of the location-related information and for the corresponding Internet product. This product on the Internet page of the information provider may also be counterfinanced entirely or in part by advertising.

Another business model is that the information provider does not encode the location-related information and provide it on the Internet but instead turns this over to a service provider. In this case, a link to the page of the service provider is preferably set up on an Internet page of the information provider. By selecting this link, a customer of the information provider

5 reaches the Internet page of the service provider in order to download the desired location-related information. For this service, the information provider pays the service provider a flat rate or a use-based fee. As an alternative or in addition, it is possible in this business model to at least partially counterfinance the service of the service provider through advertising on the service provider's Internet page.

10

Another business model is that the service provider makes a fee-based portal available from which end customers are able to download location-related information concerning, for example, points of interest, for a fee.

15 Furthermore, the methods for encoding and decoding and, based on these, the method of the present invention for transmitting location-related information from a transmitter to a receiver, are explained in greater detail with reference to the drawing:

Figure 1 shows a segment of a road map and a received object to be decoded,

20

Figure 2 shows a representation of the objects according to Figure 1 converted into a scatter plot,

Figure 3 shows a matrix of the number of captured points,

25

Figure 4 shows the adjusted scatter plot of the object to be decoded and the scatter plot of the objects from the database,

Figure 5 shows a filter mask derived from an object to be decoded,

30

Figure 6 shows a table which contains captured points along the decoded object,

Figure 7 shows a table for assigning the points to stretch elements, and

Figure 8 shows a flow chart of the method according to the present invention for transmitting location-related information.

Figure 1 shows a segment from a digital map stored in the receiver including a road network 1, interpolation points 2 being stored as vectors with information connecting interpolation points 2 with each other by stretch elements 3. An object 4 to be encoded is made up of a polyline having interpolation points 5 and stretch elements 6. In addition, the object to be encoded has an endpoint 7 which is connected to the adjacent interpolation point 9 via a stretch element 8. As seen in Figure 1, stretch line 5, 6 is distinguished from a portion of road network 1 only by a parallel shift. This may be caused, for example, by the use of different geographical coordinates in the transmitter and receiver.

In a preferred embodiment of the present invention, the object to be encoded includes traffic routes having characteristic properties which are also present on the receiver's digital road map. In a preferred embodiment of the present invention, road network 1 and object 4 for encoding are depicted by equidistant points 10, 11 (Figure 2). This is done by interpolation, in the simplest case by successive addition of differential displacement vectors. The interpolation distances are equal in each case. Obtained points 10, 11 are stored.

A preferred data format is described in patent application DE 100 23 309. The database separately includes both location as well as descriptive information. Assignment information is used for assigning at least one portion of the location information to at least one portion of the descriptive information. Structural information and interpretation rules, if necessary, are located in a header part. In another preferred embodiment of the present invention, the addresses of the original stretch elements are included in a suitable manner so that a memory space-saving list of the original addresses of the stretch elements and the offsets of the interpolation points is present in the memory within the particular point set.

The point set derived from traffic route network 1 is denoted as K in the following. For the purpose of decoding, the number of points of the traffic route network which lie within a predetermined distance of at least one point of object 4 is determined preferably for a plurality of relative positions of the point set of object 4 with respect to traffic route network 1. It is assumed that only a slight displacement takes place between the traffic route network and object 4.

The point set of object 4 is used as filter mask F (example in Figure 5), a capture radius  $r$  being assigned to each of points 11. Furthermore, the filter mask is displaced in the  $x$  and  $y$  direction, as is suggested by a grid 12 in Figure 2. A check is made at each point of displacement  $(x, y)$  to determine if one or a plurality of points  $K_m$  of point set  $K$  lie within a circle having radius  $r$  about a point  $F_n$  of filter mask  $F$ , i.e., if the condition

$$\lfloor |F_{x,y,n} - K_m| \leq r \rfloor = \{0;1\}$$

is met. The points of the road network that lie within capture radius  $r$  of at least one point of object 4 are denoted in the following as captured points. By adding up the results, the total number of the captured points is determined according to the following equation:

$$GP_{x,y} = \sum_n \sum_m \lfloor |F_{x,y,n} - K_m| \leq r \rfloor$$

In doing this, the table shown in Figure 3 is obtained, in which it is determined that the largest number, namely 97, is present in the displacement “ $x_{\max} = 1$ ” and “ $y_{\max} = 8$ ”. The coordinate chain is decoded in the relative position in which the total number is largest. Figure 4 shows a scatter plot of road network 1 and of object 4 to be decoded which is displaced by  $x_{\max}$  and  $y_{\max}$ , the points correlating with the points of the road network being highlighted by Xs.

After this process, it is possible to check the plausibility of the obtained displacements. To that end, only the captured points must be checked for partial consistency of their chaining, which is the result, for example, of a bit mask of the affected stretch line being run via an And function and gaps (coherent regions of non-captured points) being detected.

If necessary, a precision correction may be performed through another step, to which end the already displaced filter mask is displaced in smaller steps so that the sum of the squares of the absolute value of the vector sums of the difference vectors of the individual points of the filter mask is minimized to the captured points of the road network. In the event of only one captured point per point of the filter mask, the result is the usual minimum error square. A

plurality of captured points results in the mask being “suspended” into the point set of the road network in an optimum manner.

In detail, this takes place as follows: The filter mask impacted by the roughly determined displacement is again correlated with the points of the road network, the arrays (with size of (F) = N) of vector sums V and the number of captured points G being output. Correction displacement d must subsequently be determined according to the extremal requirement

$$\sum_n^N \left| \left( F_n + d - (1/G_n) \cdot \sum_m^{G_n} K_{gef,n} \right) \right| \rightarrow Min$$

and after formation of the partial derivation

$$\partial(...)/\partial t = \sum_n^N (d + V_n / G_n) = 0$$

the following results

$$d = -(1/N) \sum_n^N (V_n / G_n)$$

Case  $G_n = 0$  is excluded, which may occur, for example, by first initializing vector sums  $V_n$  with 0 and if  $G_n = 0$  is set,  $G_n = 1$  and  $N = N-1$ .

If a filter mask is finally displaced, the captured points may be determined individually, to which end it is determined for the individual filter points which point of the road network correlates therewith. The result of such a process is shown as a table in Figure 6. This shows that points  $F_1$  through  $F_5$  are without a corresponding point on the road network. This shows that this stretch element of the filter mask has not been entered in the receiver’s database. It may be connected thereto at point 39 of the road network.

A reference of the elements of point set K to the stretch elements of the road network is explained, for example, in the following: SE signifies the number of the stretch element, the

sequence being determined according to the transformation into point set K, which occurs in a defined direction. M\_SE represents the number of points of stretch element SE after interpolation. The reference of a captured point (with address m) to the associated stretch element may now occur through a simple formation of the cumulative sum of M\_SE-gap in that starting from SE = 1, the m to be referenced is investigated for the condition  $m \leq \text{cum\_sum}(M\_SE)$  and first stretch element SE fulfilling the condition is assigned. Figure 7 shows that it is sufficient to file an array of the cumulative sum for 1 through SE.

The flow chart of Figure 8 shows the essential steps of the method according to the present invention for transmitting location-related information. In step 101, the customer establishes a connection between his/her computer and the server on which an Internet page of the service provider or of the information provider is located. In step 102, the customer loads the Internet page of the service provider or information provider. From this Internet page it is possible to access a database having location-related information. In another embodiment of the present invention, the customer must first follow a link to reach the database having location-related information. In step 103, the customer downloads the database having the location-related information.

In step 104, the data is transferred from the customer's computer to his/her navigation device. The transfer may be made via a connection of the navigation device to the Internet or via a transportable storage medium such as a diskette. Different embodiments of the present invention have to be seen in connection with different financing models.

Case 1: The information provider pays for the service of the service provider. Such financing is appropriate if the information provider has an interest in the user obtaining the offered information. The information provider might be, for example, a restaurant owner and the user a prospective guest. The restaurant owner might pay the service provider one time for encoding the location of the restaurant. It then makes sense that the access to the database having the location-related information is made directly via the home page of the restaurant owner.

Access might also take place via a link on the home page of the restaurant owner, which directs the customer to the Internet page of the service provider.

This constellation is appropriate if the service provider and information provider have not arranged a one-time payment but instead a use-based payment. If the database having the location-related information is found on an Internet page of the service provider, the service provider has the possibility to monitor use. An update of the database may involve a low expense.

Case 2: The user pays the service provider for the service. In this constellation, the service provider and the information provider might also be one and the same party. The service provider might have an interest in providing information in the interest of generating income.

It is then appropriate that user access to the database having the location-related information is provided via an Internet page of the service provider. Of course, it is also possible for the user to reach the Internet page of the service provider only via a page referring to the location-related information. Either a flat rate or a use-dependent payment may be stipulated for usage. The user must be identifiable, for example, directly through the user name and password or indirectly. Identification by user name and password is appropriate in particular if a flat rate has been established between the service provider and user. A use-based payment may also be achieved by selecting the user under a specified number.

Case 3: The service is financed by advertising. It is possible to implement such financing easily if the user must access an Internet page of the service provider. In this alternative, the user automatically opens advertised offers as soon as the Internet page of the service provider is loaded. Hybrids of all three cases are also possible.



## List of Reference Symbols

Traffic route network	1
Interpolation points	2
Stretch elements	3
Object to be decoded	4
Interpolation points	5
Stretch elements	6
End point	7
Stretch element	8
Interpolation point	9
Equidistant points	10
Equidistant points	11
Grid	12